Results of Two Boat Trawling for Juvenile Salmonids in Discovery Passage and Nearby Channels, Northern Strait of Georgia

C. D. Levings and M. Kotyk

Department of Fisheries and Oceans
Fisheries Research Branch
4160 Marine Drive
West Vancouver, British Columbia

November 1983

Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 1730

Canadian Manuscript Report of Fisheries and Aquatic Sciences

These reports contain scientific and technical information that represents an important contribution to existing knowledge but which for some reason may not be appropriate for primary scientific (i.e. *Journal*) publication. They differ from Technical Reports in terms of subject scope and potential audience: Manuscript Reports deal primarily with national or regional problems and distribution is generally restricted to institutions or individuals located in particular regions of Canada. No restriction is placed on subject matter and the series reflects the broad interests and policies of the Department of Fisheries and Oceans, namely, fisheries management, technology and development, ocean sciences, and aquatic environments relevant to Canada.

Manuscript Reports may be cited as full publications. The correct citation appears above the abstract of each report. Each report will be abstracted by *Aquatic Sciences and Fisheries Abstracts* and will be indexed annually in the Department's index to scientific and technical publications.

Numbers 1-900 in this series were issued as Manuscript Reports (Biological Series) of the Biological Board of Canada, and subsequent to 1937 when the name of the Board was changed by Act of Parliament, as Manuscript Reports (Biological Series) of the Fisheries Research Board of Canada. Numbers 901-1425 were issued as Manuscript Reports of the Fisheries Research Board of Canada. Numbers 1426-1550 were issued as Department of Fisheries and the Environment, Fisheries and Marine Service Manuscript Reports. The current series name was changed with report number 1551.

Details on the availability of Manuscript Reports in hard copy may be obtained from the issuing establishment indicated on the front cover.

Rapport manuscrit canadien des sciences halieutiques et aquatiques

Ces rapports contiennent des renseignements scientifiques et techniques qui constituent une contribution importante aux connaissances actuelles mais qui, pour une raison ou pour une autre, ne semblent pas appropriés pour la publication dans un journal scientifique. Ils se distinguent des Rapports techniques par la portée du sujet et le lecteur visé; en effet, ils s'attachent principalement à des problèmes d'ordre national ou régional et la distribution en est généralement limitée aux organismes et aux personnes de régions particulières du Canada. Il n'y a aucune restriction quant au sujet; de fait, la série reflète la vaste gamme des intérêts et des politiques du Ministère des Pêches et des Océans, notamment gestion des pêches; techniques et développement, sciences océaniques et environnements aquatiques, au Canada.

Les Manuscrits peuvent être considérés comme des publications complètes. Le titre exact paraît au haut du résumé de chaque rapport, qui sera publié dans la revue *Aquatic Sciences and Fisheries Abstracts* et qui figuera dans l'index annuel des publications scientifiques et techniques du Ministère.

Les numéros de 1 à 900 de cette série ont été publiés à titre de manuscrits (Série biologique) de l'Office de biologie du Canada, et après le changement de la désignation de cet organisme par décret du Parlement, en 1937, ont été classés en tant que manuscrits (Série biologique) de l'Office des recherches sur les pêcheries du Canada. Les numéros allant de 901 à 1425 ont été publiés à titre de manuscrits de l'Office des recherches sur les pêcheries du Canada. Les numéros 1426 à 1550 ont été publiés à titre de Rapport manuscrits du Service des pêches et de la mer, Ministère des Pêches et de l'Environnement. Le nom de la série a été changé à partir du rapport numéro 1551.

La page couverture porte le nom de l'établissement auteur où l'on peut se procurer les rapports sous couverture cartonnée.

Canadian Manuscript Report of Fisheries
and Aquatic Sciences No. 1730

November 1983

RESULTS OF TWO BOAT TRAWLING FOR JUVENILE SALMONIDS IN DISCOVERY PASSAGE AND NEARBY CHANNELS, NORTHERN STRAIT OF GEORGIA.

by

C. D. Levings and M. Kotyk

Department of Fisheries and Oceans
Fisheries Research Branch
West Vancouver Laboratory
4160 Marine Drive
West Vancouver, British Columbia V7V 1N6

(c)Minister of Supply and Services Canada 1983
Cat. No. Fs 97-4/1730 ISSN 0706-6473

ABSTRACT

Levings, C.D., and M. Kotyk. 1983. Results of two boat trawling for juvenile salmonids in Discovery Passage and nearby channels, northern Strait of Georgia. Can. MS Rep. Fish. Aquat. Sci.: 1730: iv + 55 p.

Chum, pink, coho, chinook, steelhead, and sockeye juvenile were sampled with a two boat trawl in channels leading off the northern Strait of Georgia. Chum dominated the catches and peaked in abundance in late June, as did pinks. It is probable that the majority of the chum were from the Fraser system. Chinook and coho were less abundant and were primarily fish from Quinsam hatchery. Steelhead and sockeye were uncommon. Length frequency data are given for fish subsampled from the trawls. Judging from data obtained in June 1983, most of the chum migrating to sea from the northern Strait of Georgia use Discovery Passage. If stock composition were determined, Discovery Passage could be a useful monitoring location for migrating juvenile salmonids.

Key Words: Juvenile salmonids, Campbell River estuary, Discovery Passage, two boat trawling, length, catch data.

RÉSUMÉ

Levings, C. D., and M. Kotyk. 1983. Results of two boat trawling for juvenile salmonids in Discovery Passage and nearby channels, northern Strait of Georgia. Can. MS Rep. Fish. Aquat. Sci.: 1730: iv + 55 p.

Des saumons kétas, roses, cohos, quinnats, des truites arc-en-ciel, ainsi que des saumons sockeyes juvéniles ont été échantillonnés au moyen d'un chalut boeuf dans des chenaux menant au large de la partie nord du détroit de Géorgie. Les saumons kétas ont dominé les prises et ont été les plus abondants à la fin juin, comme les saumons roses. Il est probable que la majorité des saumons kétas provenaient du réseau hydrographique du fleuve Fraser. Les saumons quinnats et cohos, moins abondants, provenaient surtout de la piscifacture Quinsam. Les truites arc-en-ciel et les saumons sockeyes étaient peu fréquents. Les données sur la fréquence des longueurs sont présentées pour les poissons sous-échantillonnés provenant des chaluts. À en juger d'après les données obtenues en juin 1983, la plupart des saumons kétas qui quittent la partie nord du détroit de Géorgie pour se rendre en mer empruntent le passage Discovery. Si l'on déterminait la composition des stocks, le passage Discovery pourrait être un bon endroit de surveillance des jeunes salmonidés en migration.

Mots-clés: salmonidés juvéniles, estuaire de la rivière Campbell, passage Discovery, chalutage à boeuf, longueur, données sur les prises.

INTRODUCTION

A sampling program to establish the dispersal of wild chinook fry and juvenile marked chinook from release experiments at Quinsam hatchery into the Campbell River estuary included two boat trawling surveys in Discovery Passage. This report presents the results of these studies which were conducted over the period March to August 1982 and June 1983. Data are given on all species of salmonids taken. Although there are considerable data on distributions and sizes of juvenile salmon in the southern Strait of Georgia (e.g. Healey 1980) there is no information north of Cape Lazo or from important migratory routes such as Discovery Passage.

METHODOLOGY

A standard "Kodiak" surface trawl (width 6 m, depth 3.1 m), similar to that described in Bagenal (1978) was used. Dimensions of the net and mesh sizes are shown in Fig. 1. The net was deployed using R/V ACTIVE LASS (14 m, 96 hp) and a chartered codboat (MISS DEBRA: 10 m, 75 hp). Tows were standardized at 10 min duration but were often shortened due to currents and/or fish abundance. The direction of the tows depended on tidal current conditions. Usually the boats were about 30 m apart, but this could not be rigidly controlled because of strong tidal eddies. Stations occupied are shown in Fig 2. These areas were chosen to match beach seine sites used in a parallel and complementary study examining fish use of foreshore habitats (Brown et al. 1983). Because of the extreme tidal currents in Discovery Passage, some of the locations could only be sampled at or near slack water. When conditions permitted duplicate tows were made. The data presented here represent minimum catches as fish were sometimes visible on the surface at locations other than those routinely sampled. Schools were often observed within 100 m of the beach and sometimes were associated with kelp beds (Nereocystis lutkeana) which developed by June.

Two boat trawling in 1983 was conducted only during June 15 to 20. The same suite of stations was occupied in Discovery Passage and additional locations east of Quadra Island (Fig. 2) were sampled to determine if fish were using alternative migratory routes such as those offered by Hoskyn, Sutil, and Lewis Channels.

Subsamples of fish for length and weight determinations were obtained from the catches and fixed in 10% formalin. In some instances larger fish (e.g. coho smolts) were measured and released.

RESULTS AND DISCUSSION

Results of two boat trawling are shown in Tables 1 to 14 for 1982 and 15 to 19 for 1983. Data on individual species of salmonids are given below.

A. Catches and size distributions of fish

(i) Chinook

1982 - Compared to pink and chum, few chinook were taken in the samples and did not appear until May 5 when 2 marked fish were caught off Tyee Spit (Table 6). These were fish from the first release (May 5) of the time-and-size-at-release experiment with chinook from Quinsam hatchery (Bilton et al. 1983). In mid-June one marked chinook was taken off Tyee Spit (Table 6) and another at Canoe Pass (Table 8, 9).

Maximum numbers of marked chinook were caught in the mid-July trips, when 4 were taken at Painters, 12 at Duncan Bay (Table 11), and 12 at Menzies Bay (Table 12). In August only 1 marked chinook was obtained, at April Point (Table 14).

Chinook size frequency distributions for July 1982 are shown in Figure 3. Unmarked fish in the lower size ranges are possibly wild stock but also could be smaller unmarked hatchery fish.

The proportion of marked chinook in individual catches ranged from 0 to 50% in individual catches. Coded wire tags from 14 of the marked chinook caught in 1982 were dissected and decoded. All were from Quinsam hatchery (1981 brood year) except for one fish reared at the Little Qualicum hatchery (1981 Big Qualicum brood stock). Computed over all the samples the ratio of marked to unmarked fish was 33.3%, less than the proportion of marked fish released from the hatchery (53.2%). This indicates that some dilution of the marked population in Discovery Passage was occurring as wild fish moved into open water habitat from the river and estuary.

1983 - The largest catch of chinook was at April Point on June 15 where a total of 26 were taken. Three were marked, and all were from Quinsam hatchery production releases in May 1982. A marked chinook taken at Menzies Bay on June 16 was from an experimental hatchery release on May 5, 1983. One mark caught on the same day at Plumper Bay was from an experimental release into the estuary on April 21, 1983. Other catches at stations elsewhere in Discovery Passage averaged <1 chinook per set. No chinook were caught in the channels east of Quadra Island. Mean length of unmarked chinook was 125 mm (s = 13, n = 18) compared to 115.4 mm (s = 17.8 mm) for marked chinook.

(ii) Pink

1982 - A few pink fry (<10 per tow) were taken in the trawls over the

period March to early May. These fish were <45 mm in length and probably were from local rivers, including the Campbell. During this period pinks were recorded from Quathiaski Cove (Table 1, 3) and off Hidden Basin (Table 4), all stations south of Seymour Narrows.

Pinks appeared in catches at most stations throughout the study area in mid-June and were present in all June and July trips. The maximum catch was in Deepwater Bay on July 15 (Table 12), when approximately 330 were taken. Pinks from June and July were much larger than those taken earlier and ranged from approximately 60 to 100 mm (Fig. 5). Fish from this time period were probably from stocks other than the Campbell River, possibly from the Fraser River where outmigrations of pink occurred in 1982.

1983 - Pinks were rare in the samples and only 3 individuals were taken in the sets, all at Deepwater Bay (Table 16). None were taken in the channels east of Quadra Island.

(iii) Coho

1982 - Coho were not taken until late May, subsequent to major releases from the Quinsam hatchery. Seventy-eight and 62 were taken in tows at Duncan Bay on May 28 and 29, respectively (Table 6, 7). None were taken at stations north of Seymour Narrows on the latter trip but by mid-June coho were taken in Plumper B y (Table 9). The proportion of marked coho ranged from 0 to 100% in individual catches but over all was 7.0%. This is close to the percent of marked coho released from Quinsam hatchery in 1982 (6.3%).

Smolts caught in mid channel were larger than those from tows close to the beach. For example smolts taken on June 15 at the Big Rock offshore station were of mean length 175 mm (s = 17) compared to 139 mm (s = 13) for coho from Tyee Spit. This length difference was significant as judged by ANOVA ($P < 0.05$; df = 1, 11; $F = 16.5$).

1983 - A total of 11 coho were caught in the Discovery Passage sampling, 9 at Deepwater Bay (Table 16) and 2 at April Point (Table 15). None were marked. Coho were caught only in Discovery Passage.

(iv) Chum

1982 - A few chum fry (<50 mm) were taken in the trawls in the early part of the season and larger fish began to appear in mid-June. The temporal pattern of chum catches was quite similar to that for pinks but catches in June and July were much larger. The maximum catch for chum was 3220 (estimated) off Painters Lodge on July 14 (Tabl- 11). There appeared to be little differences in catches north or south of Seymour Narrows.

Length frequency data for chum taken in 1982 at selected locations are shown in Figures 5, 6, 7, 8, and 9. Modal length of chum at stations south of Seymour Narrows was slightly larger than for fish caught north of the Narrows. For example, chum from Canoe Pass showed modal length of approximately 90 mm while fish taken onthe same day at

Plumper Bay were about 70 mm (Fig. 5, 6). Chum caught in July were slightly larger at comparable stations (Fig. 7, 8, 9).

1983 - Chum were the most abundant fish in the trawl catches. The largest catch of this species was 745, taken at April Point on June 15 (Table 15). Tows at channels east of Quadra Island yielded fewer chum and in this area the maximum catch was 52 in Lewis Channel on June 21 (Table 19). CPUE for Discovery Passage was 90.0 (19 tows) compared to 9.4 (19 tows) for channels east of Quadra.

In 1983, chum from channels east of Quadra Island showed a broad peak in length frequencies, ranging from 54 to 108 mm (Fig. 10). Mean length was 79 mm (s = 13). As in 1982, chum appeared to be larger in Discovery Passage south of Seymour Narrows, where mean and modal length >85 mm (Figs. 11, 12, 13). North of Seymour Narrows (Plumper, Deepwater Bay) mean and modal length was approximately 82 mm (s = 13) and 80 mm respectively (Fig. 14).

Other salmonids - Sockeye were not caught in 1982. Samples were searched thoroughly for this species but none were found. In 1983 two sockeye smolts were taken on June 16 and 17 at Canoe Pass and Maude Beach respectively (Table 16, 17). In 1982 a steelhead (30 cm) was taken at Menzies Bay on June 16 (Table 9).

B. Abundance and origin of fish

Few chum schools were observed in mid-channel locations during the period of maximum abundance in late June, indicating the habitat within a few tens of metres off the beach is an important migratory zone in Discovery Passage. Although our sampling was biased toward near shore sites the few sets that were made "offshore" did not catch any chum. Reduced current velocities, eddy structures, and kelp beds may be significant features of the nearshore habitat, but further work is required to verify this.

Nearshore catches of chum in late June at Discovery Passage were among the highest reported in the available literature for B.C. and Washington, so the area is an important migrating and/or concentrating location. The channels east of Quadra Island are of lesser significance, at least as judged by the June 1983 sampling. Comparable maximum two boat trawl catches (>1000 per 10 min tow) were reported in Burke Channel, a migratory route for Bella Coola River chums, by Parker (1970). Barraclough and Phillips (1978) showed that offshore chum catches from two boat trawls in the Strait of Georgia were maximum (101-200 fish per set) in late April - early May and were relatively scarce by July. As mentioned above a high proportion of chum taken at Discovery Passage in late June - early July may be from the Fraser, as also speculated by Healey (1980). In 1982 chum fry catches in beach seines on Roberts Bank, Fraser estuary, peaked in mid May (A. Macdonald, unpublished data) indicating a transit time of slightly over a month to Discovery Passage. Manzer (1956) mentioned that chum in beach seine catches at Alert Bay, north of Discovery Passage, increased in late July and early August. The chum may therefore take about one month to travel through Discovery Passage and southern Johnstone Strait. Some Fraser

chums may also leave the Strait of Georgia to the south, but this species and other juvenile salmonids were relatively rare in nearshore trawls conducted over 3 y in Juan de Fuca Strait (Miller et al. 1980). In 168 hauls only 40 chum were taken compared to several thousand at our study area (185 hauls). Chum north of Seymour Narrows were smaller which may reflect their origin from rivers closer to the study area (e.g. stocks from Bute Inlet). These fish probably entered Discovery Passage via channels to the north and east (e.g. Okisollo Channel).

Juvenile chinook and coho were also less abundant than pink and chum in trawls off the Fraser (Barraclough and Phillips 1978) and in Burke Channel (Parker 1970), indicating these two species are either relatively scarce or are able to avoid the trawls. Kjelson (1982) obtained more chinook using trawls in the Sacramento River and estuary, California, but fish were constrained by the river channel and probably were more concentrated.

Pink salmon catches from two boat trawls at Discovery Passage in mid-summer were comparable to some sets from the western side of the Strait of Georgia (101-200 fish per set; Barraclough and Phillips 1978). As with chum, pink were most abundant in late April - early May. Pink fry catches at Roberts Bank peaked in mid-May 1982, once again indicating a residence time of about 1 month, assuming some Fraser River fish are involved. Pink catches at Discovery Passage were much lower than reported for Burke Channel in 1965 (>1000 for 10 min tow) (Parker 1970). As mentioned above the latter is a well known migratory route for fry from the Bella Coola river.

Since it appears Discovery Passage is an important migratory route for fish leaving the Strait of Georgia, notably chum, this area has a good potential for investigating several aspects of the early sea life of salmon. By coordinating sampling of downstream migrants, for example at Mission on the Fraser (e.g. Todd 1965 in Barraclough and Phillips 1978) or Big Qualicum (e.g. Fraser et al. 1979) with work at Discovery Passage important information such as survivorship, migration rates, growth rates, and stock composition could be obtained. Since the two boat trawl has some features in common with the sampling device used at Mission the abundance data might in fact be relatively comparable.

ACKNOWLEDGMENTS

Thanks are due to S. Matheson and R. Pidcock for their excellent boat handling and cooperation during trawling. Assistance in the field and lab was provided by D. Gordon, L. Coultish, S. Macdonald, and M. St. John.

REFERENCES

Bagenal, T. (Ed.). 1978. Methods for assessment of fish production in fresh water. IBP Handbook No. 3 (3rd Edition). Blackwell, London. 365 p.

Barraclough, W.E. and A.C. Phillips. 1978. Distribution of juvenile salmon in the southern Strait of Georgia during the period April to July 1966 - 1969. Fish. Environ. Canada. Fish. Mar. Serv. Tech. Rep. 826. 47 p.

Bilton, H.T., Coburn, A.S. and R.B. Morley. 1983. Time and size at release experiment: four releases of three size categories of juvenile chinook salmon from the Quinsam hatchery in the spring of 1982. Can. Data Rep. Fish. Aquat. Sci. No. 397. iv + 18 p.

Brown, T.J., C.D. McAllister, C.D. Levings, M. Kotyk. 1983. Salmonid catch data from Campbell River and Discovery Passage 1982. Can. Data Rep. Fish. Aquat. Sci. (in press).

Fraser, F.J., Berry, S.J., and B. Allen. 1979. Big Qualicum River Salmon Development Project, Volume IV: Chum Fry Marine Study. Fish. Environ. Canada. Fish. Mar. Serv. Tech. Rep. 824. 32 p.

Healey, M.C. 1980. The ecology of juvenile salmon in Georgia Strait, British Columbia p. 203-229 in McNeil, W.J., and D.C. Himsworth (Ed.). Salmonid Ecosystems of the North Pacific. Oregon State University Press, Corvallis, Ore.

Kjelson, M.A. P.F. Raquel and F.W. Fisher. 1982. Life history of fall-run juvenile chinook salmon, Oncorhynchus tshawytscha, in the Sacramento-San Joaquin estuary, California. p. 393-411 in Kennedy, U.S. (Ed.). Estuarine Comparisons. Academic Press, New York.

Manzer, J.I. 1956. Distribution and movement of young Pacific salmon during early ocean residence. Fish. Res. Bd. Can. Prog. Rep. Pac. Coast. Stn. 106: 24-28.

Miller, B.C., C.A. Simenstad, J.N. Cross, K.L. Fresh and S.N. Steinfort. 1980. Nearshore fish and macroinvertebrate assemblages along the Strait of Juan De Fuca including food habits of the common nearshore fish. Final report of three years sampling. U.S. Environmental Protection Agency 600/7-80-027. 211 p.

Parker, R.R. 1970. Observations on the 1964 brood year of Bella Coola pink salmon as juveniles in Burke Channel and seaward channels in 1965. Fish. Res. Board Can. Man. Rep. Ser. 1974. 60 p.

LIST OF TABLES

Table 1. Results of two boat trawling in Discovery Passage on March 24, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 2. Results of two boat trawling in Discovery Passage on April 14, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 3. Results of two boat trawling in Discovery Passage on April 15, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 4. Results of two boat trawling in Discovery Passage on May 4, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 5. Results of two boat trawling in Discovery Passage on May 5, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 6. Results of two boat trawling in Discovery Passage on May 28, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 7. Results of two boat trawling in Discovery Passage on May 29, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 8. Results of two boat trawling in Discovery Passage on June 15, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 9. Results of two boat trawling in Discovery Passage on June 16, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 10. R su ts f two boat trawling in Discovery Passage on June 17, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 11. Results of two boat trawling in Discovery Passage on July 14, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 12. Results of two boat trawling in Discovery Passage on July 15, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 13. Results of two boat trawling in Discovery Passage on August 24 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 14. Results of two boat trawling in Discovery Passage on August 25 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 15. Results of two boat trawling in Discovery Passage on June 15, 1983. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 16. Results of two boat trawling in Discovery Passage on June 16, 1983. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 17. Results of two boat trawling in Discovery Passage on June 17, 1983. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 18. Results of two boat trawling in channels east of Quadra Island on June 20, 1983. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 19. Results of two boat trawling in channels east of Quadra Island on June 21, 1983. Data have been standardized to a 10 min tow. Times are PST. Legend: + = >10; ++ = <100; +++ = >1000; ++++ = >1000.

Table 1. Results of two boat trawling in Discovery Passage on March 24, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Coho mark	Steel-head	Comments Time
Tyee Spit Rep. 1	0	0	0	0	0	0	0	1580-1600
Tyee Spit Rep. 2	0	0	0	0	0	0	0	1601-1610
Quathiaski Rep. 1	0	0	0	0	0	0	0	1350-1400
Quathiaski Rep. 2	7	0	0	0	0	0	0	1401-1412
Quathiaski Rep. 3	0	0	0	0	0	0	0	1514-1521 Herring larvae+
Outer Gowlland Rep. 1	0	0	0	0	0	0	0	1015-1030
Outer Gowlland Rep. 2	0	0	0	0	0	0	0	1035-1045
Outer Gowlland Rep. 3	0	0	0	0	0	0	0	1050-1105
Outer Gowland Rep. 4	0	0	0	0	0	0	0	1050-1115 Herring larvae+
Canoe Pass Rep. 1	0	0	0	0	0	0	0	
Canoe Pass Rep. 2	0	0	0	0	0	0	0	
Menzies North Rep. 1	0	0	0	0	0	0	0	
Menzies North Rep. 2	0	0	0	0	0	0	0	
Plumper Rep. 1	0	0	0	0	0	0	0	
Plumper Rep. 2	0	0	0	0	0	0	0	
Deepwater Rep. 1	0	0	0	0	0	0	0	
Deepwater Rep. 2	0	0	0	0	0	0	0	

Table 2. Results of two boat trawling in Discovery Passage on April 14, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Coho mark	Steel-head	Comments Time
April Pt	0	0	0	0	0	0	0	1530-1542 Herring larvae +++
Canoe Pass Rep. 1	0	1	0	0	0	0	0	1328-1340
Canoe Pass Rep. 1	0	0	0	0	0	0	0	1412-1425
Menzies North Rep. 1	0	1	0	0	0	0	0	1208-1220
Menzies South Rep. 1	0	0	0	0	0	0	0	1245-1300

Table 3. Results of two boat trawling in Discovery Passage on April 15, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Coho mark	Steel-head	Comments Time
Tyee Spit Rep 1	0	1	0	0	0	0	0	0925-0935
								Herring larvae +
Hidden B si	6	4	0	0	0	0	0	0815-0825
								Herring larvae +
Big Rock Rep 1	0	0	0	0	0	0	0	
Painters Rep 3	0	0	0	0	0	0	0	1717-1727
								Herring larvae +
Painters Rep 1	0	0	0	0	0	0	0	0951-1009
								Herring larvae +
Painters Rep 2	0	1	0	0	0	0	0	1020-1035
								Herring larvae ++
Quathiaski Rep 1	5	4	0	0	0	0	0	1220-1230
								Herring larvae +
Quathiaski Rep 2	0	1	0	0	0	0	0	1242-1252
								Herring larvae +
Copper Cliff	0	0	0	0	0	0	0	1717-1727
								Herring larvae +
Duncan Bay Rep 1	0	0	0	0	0	0	0	1339-1349
								Herring larvae +
Duncan Bay Rep 2	0	0	0	0	0	0	0	1402-1412
								Herring larvae +
Outer Gowlland	1	0	0	0	0	0	0	1101-1111
								Herring larvae +
Menzies N Rep. 2	0	0	0	0	0	0	0	1452-1507
								Herring larvae +
Menzies S Rep. 2	0	1	0	0	0	0	0	1525-1535
								Herring larvae +

Table 4. Results of two boat trawling in Discovery Passage on May 4, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Coho mark	Steel-head	Comments Time
Tyee Spit Rep. 1	0	0	0	0	0	0	0	1443-1453 Herring larvae +
Tyee Spit Rep. 2	0	0	0	0	0	0	0	1506-1516 Herring larvae +
Hidden Basin	5	0	0	0	0	0	0	1150-1200 Herring larvae ++
Big Rock Rep. 1	0	1	0	0	0	0	0	1225-1235 Herring larvae +
Big Rock rep. 2	0	0	0	0	0	0	0	1317-1327 Herring larvae +
Quathiaski Rep. 1	0	0	0	0	0	0	0	0915-0927 Herring larvae +
Quathiaski Rep. 2	0	0	0	0	0	0	0	0940-0950 Herring larvae +
Cape Mudge Village	0	0	0	0	0	0	0	1020-1035 Herring larvae +

Table 5. Results of two boat trawling in Discovery Passage on May 5, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Coho mark	Steel-head	Comments Time
Tyee Spit Rep. 1	0	0	0	2	0	0	0	1524-1539 Herring larvae ++
Tyee Spit Rep. 2	0	0	0	0	0	0	0	1545-1600 Herring larvae ++
April Pt.	0	0	0	0	0	0	0	1431-1441 Herring larvae ++
Outer Gowlland	0	0	0	0	0	0	0	1358-1413 Herring larvae ++
Canoe Pass Rep. 1	0	0	0	0	0	0	0	0856-0911 Herring larva +
Menzies N Rep. 1	0	0	0	0	0	0	0	0730-0745 Herring larvae +
Menzies S Rep. 2	0	0	0	0	0	0	0	0830-0850 Herring larvae ++
Plumper Rep. 1	0	3	0	0	0	0	0	0955-1005 Herring larvae ++
Deepwater Rep. 1	0	0	0	0	0	0	0	1135-1150 Herring larvae ++
Deepwater Rep. 2	0	0	0	0	0	0	0	1216-1226 Herring larvae ++
B & K Bay	0	0	0	0	0	0	0	1241-1251 Herring larvae +

Table 6. Results of two boat trawling in Discovery Passage on May 28, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Coho mark	Steel-head	Comments Time
Tyee Spit Rep. 1	0	0	0	0	0	0	0	1513-1518
Quathiaski Rep. 1	0	0	0	0	0	0	0	1641-1651 Herring larvae ++++
Duncan Bay Rep. 1	0	0	5	0	78	1	0	1427-1437
April Pt.	0	6	0	0	3	0	0	1548-1558 Herring larvae +
Canoe Pass Rep. 1	0	0	0	0	0	0	0	0843-0853 Herring larvae ++++
Menzies N. Rep. 1	0	1	0	0	0	0	0	0950-1000 Herring larvae +
Menzies S. Rep. 1	0	0	0	0	0	0	0	0917-0927 Herring larvae +
Plumper Rep. 1	0	0	0	0	0	2	0	1037-1052 Herring larvae ++++
Deepwater Rep. 1	0	0	0	0	0	0	0	1205-1215 Herring larvae +++
B & K Bay	0	0	0	0	0	0	0	1251-1305 Herring larvae +

Table 7. Results of two boat trawling in Discovery Passage on May 29, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Coho mark	Steel-head	Comments Time
Hidden Basin	0	0	0	0	0	0	0	0854-0909 Herring larvae +
Big Rock Rep. 1	0	0	0	0	0	0	0	0814-0825 Herring larvae ++
Painters Rep. 1	0	0	0	0	0	0	0	1046-1056
Painters Rep. 2	0	1	0	0	0	0	0	1013-1023
Quathiaski Rep. 1	0	0	0	0	1	0	0	1208-1223 Herring larvae ++++
Duncan Bay Rep. 1	0	0	0	0	0	0	0	1107-1117
Duncan Bay Rep. 2	0	0	0	0	62	3	0	1346-1401 Herring larvae +

Table 8. Results of two boat trawling in Discovery Passage on June 15, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Coho mark	Steel-head	Comments Time
Tyee Spit	1	0	0	1	7	2	0	1020-1030
Hidden Basin	9	5	0	0	10	2	0	0715-0725
Big Rock Rep. 1	3	0	0	0	2	0	0	0755-0805
Big Rock Rep. 2	1	0	0	0	1	0	0	0840-0900
Big Rock Offshore	0	0	0	0	6	0	0	0907-0917
Painters Rep. 1	0	2	0	0	0	0	0	1055-1130
Painters Rep. 2	0	0	0	0	0	0	0	1115-1130
Quathiaski Rep. 1	0	1	0	0	0	0	0	1245-1300
Quathiaski Rep. 2	0	0	0	0	0	0	0	Lingcod larvae 1305-1315
Cape Mudge Village	0	0	0	0	0	0	0	1345-1355
Duncan Bay Rep. 1	0	0	0	0	1	1	0	1440-1455
Duncan Bay Rep. 1	0	0	0	0	0	0	0	1505-1520

Table 9. Results of two boat trawling in Discovery Passage on June 16, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Coho mark	Steel-head	Comments Time
Plumper Rep. 1	62*	366*	1	0	5	2	0	0726-0742
Deepwater Rep. 1	59	365	0	0	13	2	0	0825-0835
Menzies N. Rep. 1	0	0	0	0	3	0	1	0930-0938
Menzies N. Rep. 2	0	0	0	0	0	0	0	0953-1003
Menzies S. Rep. 1	0	72	0	0	0	0	0	1026-1036
Canoe Pass Rep. 1	0	316*	1	1	7	0	0	1142-1152
Tyee Spit	0	0	0	0	0	0	0	1250-1300
Tyee Spit offshore	0	0	0	0	0	0	0	1312-1322
Outer Gowlland	20	278	0	0	0	0	0	1342-1354
April Pt.	0	0	0	0	0	0	0	1422-1442

* estimated by subsampling

Table 10. Results of two boat trawling in Discovery Passage on June 17, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Coho mark	Steel-head	Comments Time
Quathiaski Cove Rep. 1	0	0	0	0	2	0	0	0855-0905 Juvenile ling cod, greenling
Quathiaski Cove Rep. 2	0	300*	0	0	5	1	0	0723-0735

* estimated by subsampling

Table 11. Results of two boat trawling in Discovery Passage on July 14, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Coho mark	Steel-head	Comments Time
Tyee Spit	10	249	0	1	0	0	0	1110-1120
Hidden Basin	2	24	0	0	0	0	0	1005-1015
Big Rock Rep. 1	0	0	0	0	0	0	0	0818-0828
Big Rock Offshore	0	9	0	0	0	0	0	0918-0928
Outer Gowlland	0	156	0	0	0	0	0	1346-1351
Painters Rep. 1	0	3220*	44	4	4	2	0	1146-1154
Duncan Bay Rep. 2	36*	670*	30	12	2	0	0	1258-1303

* estimate from subsampling

Table 12. Results of two boat trawling in Discovery Passage on July 15, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Coho mark	Steel-mark	Comments Time
Plumper Rep. 1	0	0	0	0	0	0	0	0651-0656
Plumper Rep. 2	7	18	3	2	0	0	0	0706-0716
Plumper Rep. 3	8	353	1	0	0	0	0	0729-0739
Deepwater Bay	333	840*	0	0	0	0	0	0851-0855
Menzies Bay Rep. 1	57	77	3	3	0	0	0	0954-0957
Menzies Bay Rep. 2	0	1045	13	8	0	0	0	1011-1015
Canoe Pass	6	53	2	0	0	0	0	1130-1140
Maude Beach Rep. 1	12	56	0	0	0	0	0	1159-1204
Maude Beach Rep 2	42	344	0	0	0	0	0	1222-1227
April Point	16	106	2	0	0	0	0	1331-1336
Quathiaski Cove Rep. 1	5	153	0	0	0	0	0	1401-1405
Quathiaski Cove Rep. 1	2	22	0	0	0	0	0	1417-1422

* estimate from subsampling.

Table 13. Results of two boat trawling in Discovery Passage on August 24, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Coho mark	Steel-head	Comments Time
Canoe Pass Rep. 1	0	0	0	0	0	0	0	1655-1705
Canoe Pass Rep. 2	0	0	0	0	0	0	0	1716-1726
Menzies North Rep. 1	0	0	0	0	0	0	0	1544-1554
Menzies North Rep. 2	0	0	0	0	0	0	0	1605-1615
Plumper Rep. 1	0	0	0	0	0	0	0	1251-1301
Plumper Rep. 2	0	0	0	0	0	0	0	1312-1322
Deepwater Rep. 1	0	0	0	0	0	0	0	1353-1403
Deepwater Rep. 2	0	0	0	0	0	0	0	1412-1422

Table 14. Results of two boat trawling in Discovery Passage on August 25, 1982. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Coho mark	Steel-head	Comments Time
Tyee Spit Rep. 1	0	0	0	0	0	0	0	0937-0947
Tyee Spit Rep. 2	0	0	0	0	0	0	0	1549-1559
Hidden Basin Rep. 1	0	0	0	0	0	0	0	0820-0830
Hidden Basin Rep. 2	0	0	0	0	0	0	0	0839-0849
Big Rock Rep. 1	0	0	0	0	0	0	0	0726-0736
Big Rock Rep. 2	0	0	0	0	0	0	0	0754-0804
Painters Rep. 1	0	0	0	0	0	0	0	1004-1014
Quathiaski Rep. 1	0	0	0	0	0	0	0	1520-1530
Quathiaski Rep. 2	0	0	0	0	0	0	0	1618-1628
Duncan Bay Rep. 1	0	0	0	0	0	0	0	1228-1238
Duncan Bay Rep. 2	0	0	0	0	0	0	0	1248-1358
April Point	0	0	0	1	1	0	0	1054-1104
Maude Beach Rep. 1	0	0	0	0	0	0	0	1334-1344
Maude Beach Rep. 2	0	0	0	0	0	0	0	1354-1404

Table 15. Results of two boat trawling in Discovery Passage on June 15 1983. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Comments Time
Big Rock	0	4	0	0	0	0839-0849
Q. Cove S	0	6	0	0	0	0924-0934
Q. Cove N	0	132	0	0	0	0955-1005
April Pt. Rep. 1	0	745	19	3	2*	1042-1052
April Pt. Rep. 2	0	14	0	0	0	1150-1200
Middle Pt. Rep. 1	0	90	0	0	0	1230-1240
Middle Pt. Rep. 2	0	1	0	0	1	1310-1320

* marked

Table 16. Results of two boat trawling in Discovery Passage on June 16 1983. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Sockeye	Chum	Chinook	Chinook mark	Coho	Comments Time
Hidden Basin	0	0	11	0	0	0	0715-0725
Big Rock	0	0	1	0	0	0	0800-0810
Plumper Bay Rep. 1	0	0	15	0	0	0	1225-1235
Plumper Bay Rep. 2	0	0	0	0	0	0	1250-1300
Deepwater Bay Rep. 1	2	0	165	0	1	9	1337-1347
Deepwater Bay Rep. 2	1	0	180	0	0	0	1410-1420
Menzies Bay N	0	0	1	2	0	0	1528-1538
Menzies Bay S	0	0	0	0	1	0	1555-1605
Canoe Pass	0	1	1	0	0	0	1645-1655

Table 17. Results of two boat trawling in Discovery Passage on June 17 1983. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Sockeye	Chum	Chinook	Chinook mark	Coho	Comments Time
Outer Gowlland Rep. 1	0	0	56	1	0	0	0735-0745
Outer Gowlland Rep. 2	0	0	42	1	0	0	0800-0810
Tyee Spit	0	0	0	0	0	0	0840-0850
Maude Beach	0	1	70	0	0	0	1020-1025
Menzies N	0	0	0	0	0	0	1047-1057
Menzies S	0	0	1	0	0	0	1230-1240
Canoe Pass	0	0	1	1	0	1	1325-1335
Maude Beach	0	0	0	0	0	0	1400-1410

Table 18. Results of two boat trawling in channels east of Quadra Island on June 20, 1983. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Comments Time
Village Bay Rep. 1	0	0	0	0	0	0714-0724
Village Bay Rep. 2	0	0	0	0	0	0730-0740
Conville Bay Rep. 1	0	12	0	0	0	0810-0820 herring++
Conville Bay Rep. 2	0	46	0	0	0	0845-0855
Hoskyn Channel Rep. 1	0	0	0	0	0	0915-0925
Hoskyn Channel Rep. 2	0	0	0	0	0	0934-0944
Hjorth Bay Rep. 1	0	4	0	0	0	1005-1015
Hjorth Bay Rep. 2	0	27	0	0	0	1026-1036
Hoskyn Rock Rep. 1	0	3	0	0	0	1143-1153
Hoskyn Rock Rep. 2	0	0	0	0	0	1201-1211
Coulter Island Rep. 1	0	1	0	0	0	1354-1404
Coulter Island Rep. 2	0	3	0	0	8	1415-1425
Evans Bay	0	0	0	0	0	1542-1552
Bullock South Rep. 1	0	2	0	0	0	1653-1703 herring++
Bullock South Rep. 2	0	0	0	0	0	1715-1725 Herring++

Table 19. Results of two boat trawling in channel east of Quadra Island on June 21, 1983. Data have been standardized to a 10 min tow. Times are PST. Legend: + = <10; ++ = <100; +++ = <1000; ++++ = >1000

Station	Pink	Chum	Chinook	Chinook mark	Coho	Comments Time
Redonda Light	0	2	0	0	0	0717-0727 bad tangle
Bullock East Rep. 1	0	4	0	0	0	0918-0928
Bullock East Rep. 2	0	52	0	0	0	0938-0948
Cliff Peak Rep. 1	0	4	0	0	0	1039-1049
Cliff Peak Rep. 2	0	13	0	0	0	1100-1110
Joyce Pt. Rep. 1	0	2	0	0	0	1156-1206
Joyce Pt. Rep. 2	0	3	0	0	0	1218-1228
Junction Pt. Rep. 1	0	0	0	0	0	1251-1301
Junction Pt. Rep. 2	0	2	0	0	0	1316-1326

LIST OF FIGURES

Fig. 1. Diagram of the "Kodiak" trawl net used in two boat trawling.

Fig. 2. Chart showing locations of stations occupied during two boat trawling in 1982 and 1983. Left panel - 1982, 1983; right panel 1983 only.

Fig. 3. Length frequency plot for marked (shaded) and unmarked chinook taken at Discovery Passage on July 14 and 15, 1982.

Fig. 4. Length frequency plot for pink taken at Plumper Bay on June 16, 1982.

Fig. 5. Length frequency plot for chum taken at Canoe Pass on June 16, 1982.

Fig. 6. Length frequency plot for chum taken at Plumper Bay on June 16, 1982.

Fig. 7. Length frequency plot for chum taken at Menzies Bay North on July 15, 1982.

Fig. 8. Length frequency plot for chum taken at Deepwater and Plumper Bay on July 15, 1982.

Fig. 9. Length frequency plot for chum taken at Painters Channel on July 14, 1982.

Fig. 10. Length frequency plot for chum taken at Lewis and Sutil Channels on June 20 and 21, 1983.

Fig. 11. Length frequency plot for chum taken off Hidden Basin and at the Big Rock station, June 15 and 16, 1983.

Fig. 12. Length frequency plot for chum taken at outer Gowllands and Maude Beach, June 17, 1983.

Fig. 13. Length frequency plot for chum taken at April Point and Quathiaski Cover, June 15, 1983.

Fig. 14. Length frequency plot for chum taken at Plumper and Deepwater Bay, June 16, 1983.

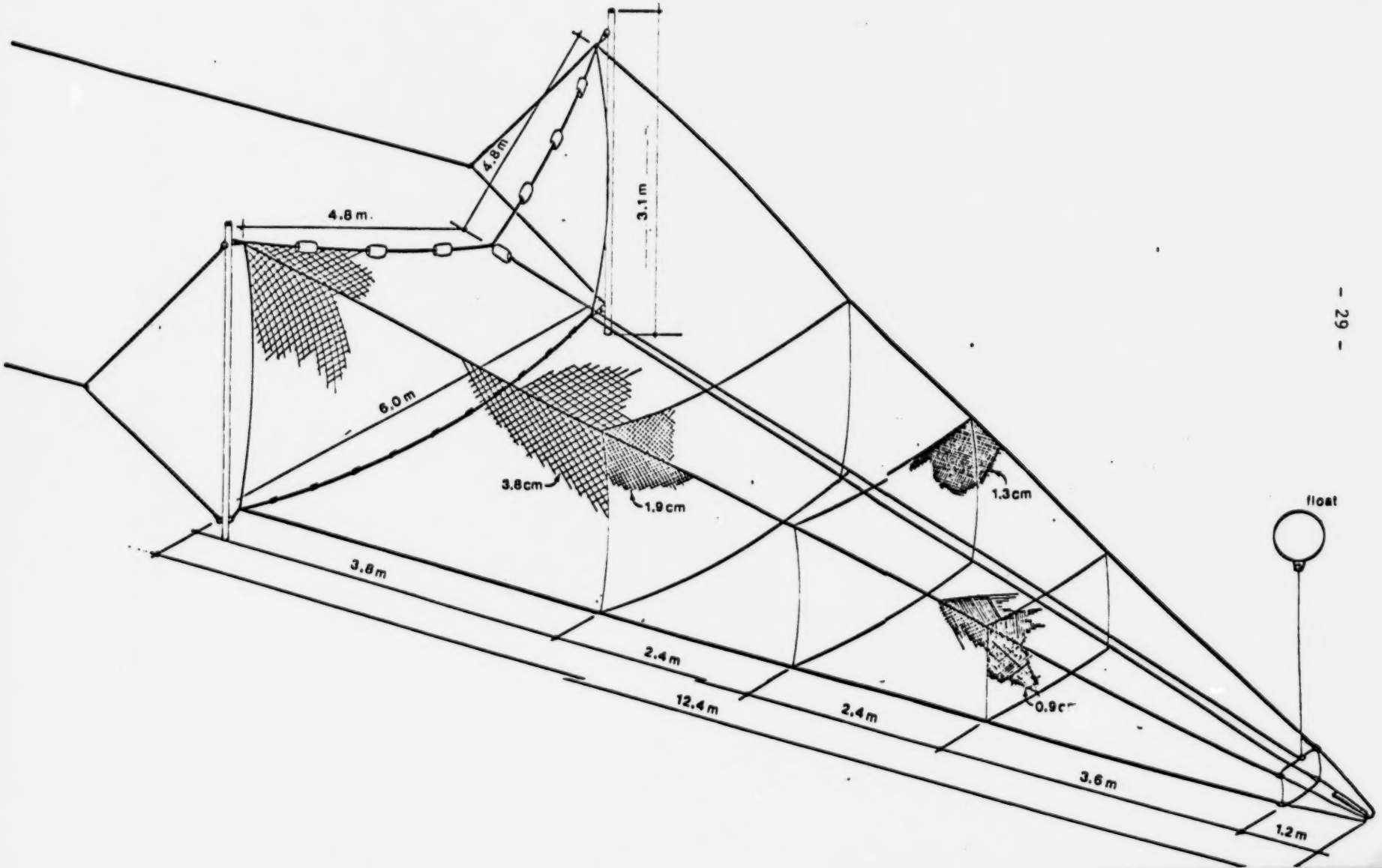
4.8m
4.8m.
3.1m
6.0m
3.8cm
1.9cm
1.3cm
float
3.8m
2.4m
12.4m
2.4m
3.6m
1.2m

Fig 2. Chart showing locations of stations occupied during two boat trawling in 1982 and 1983.

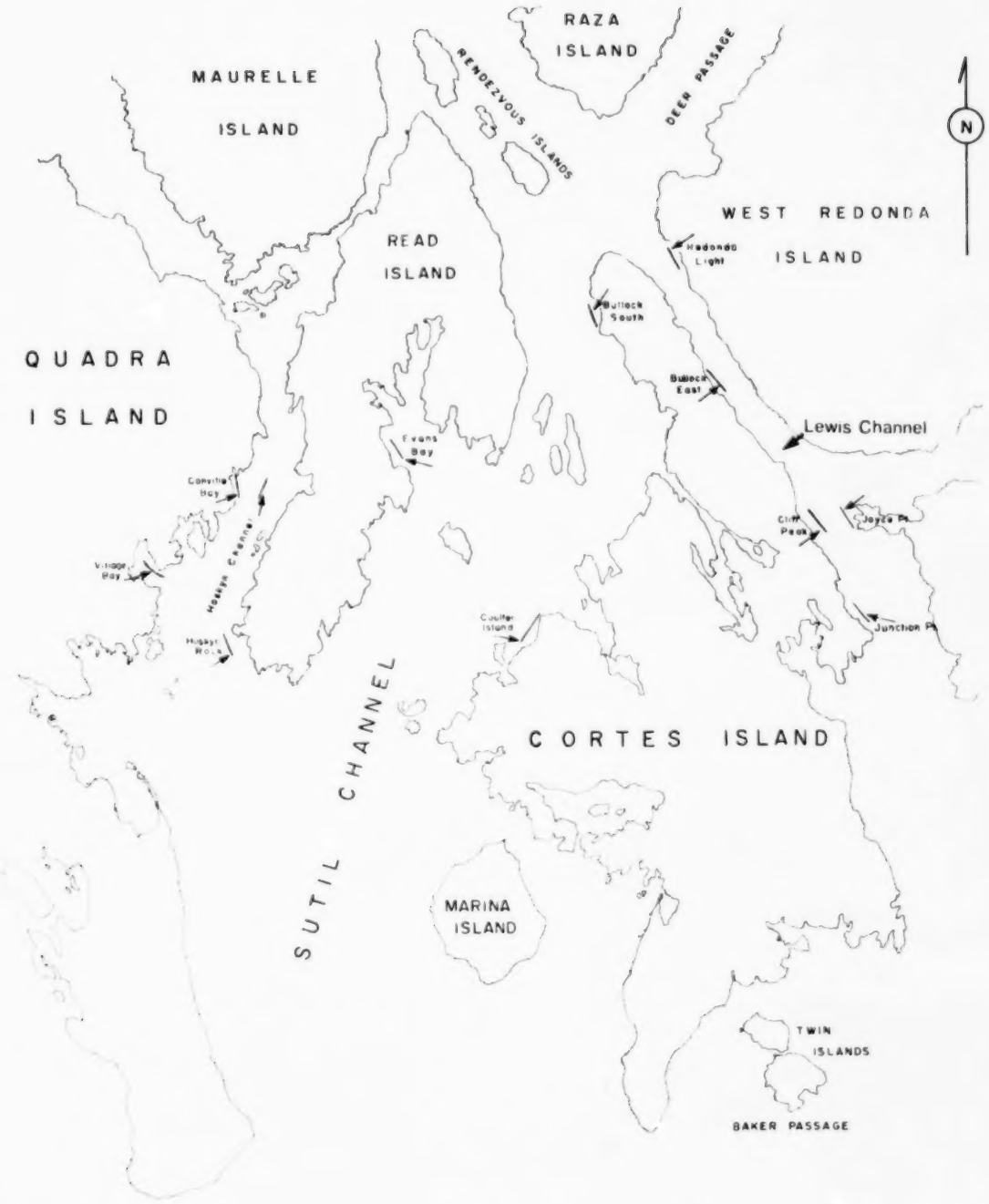

Fig. 2. Chart showing locations of stations occupied during two boat trawling in 1983.

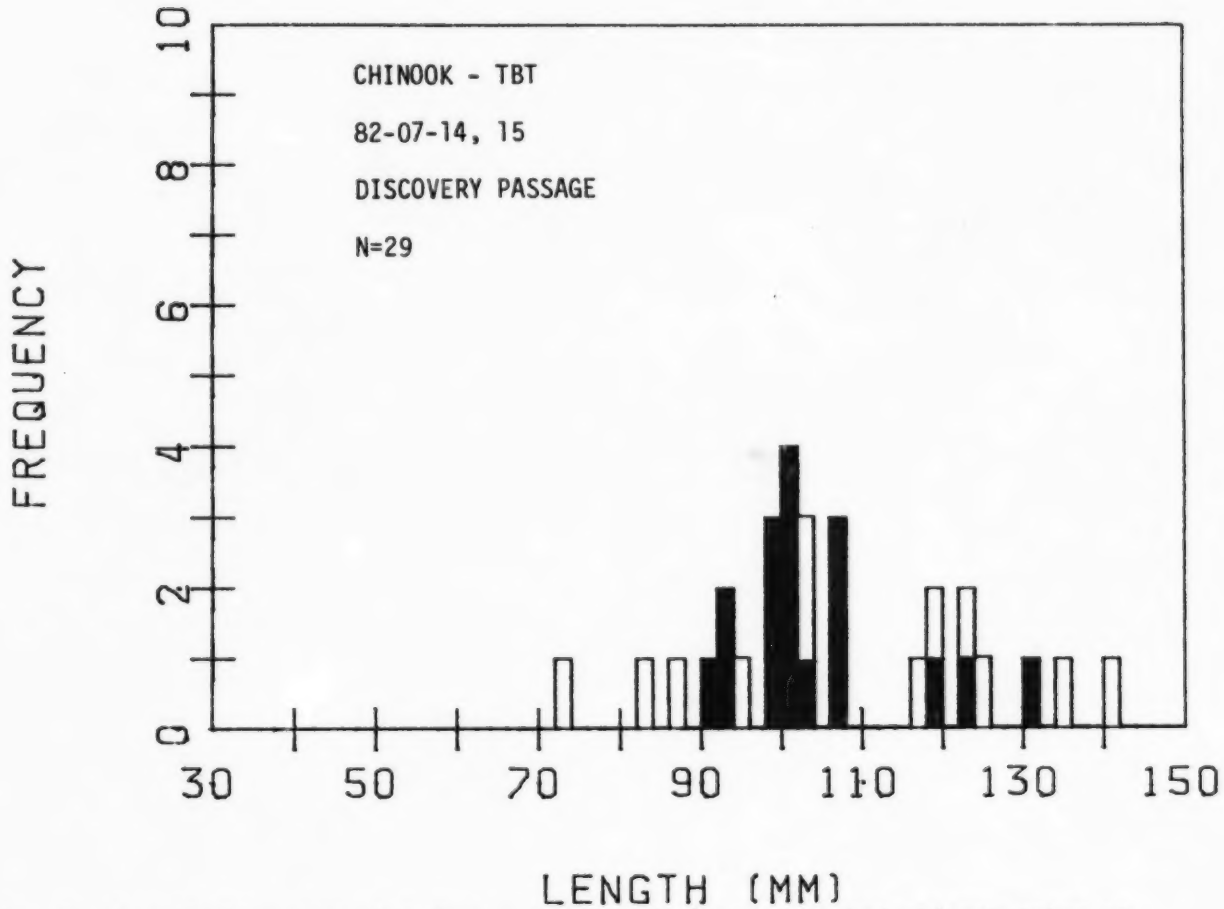

Fig. 3. Length frequency plot for marked (shaded) and unmarked chinook taken at Discovery Passage on July 14 and 15, 1982.

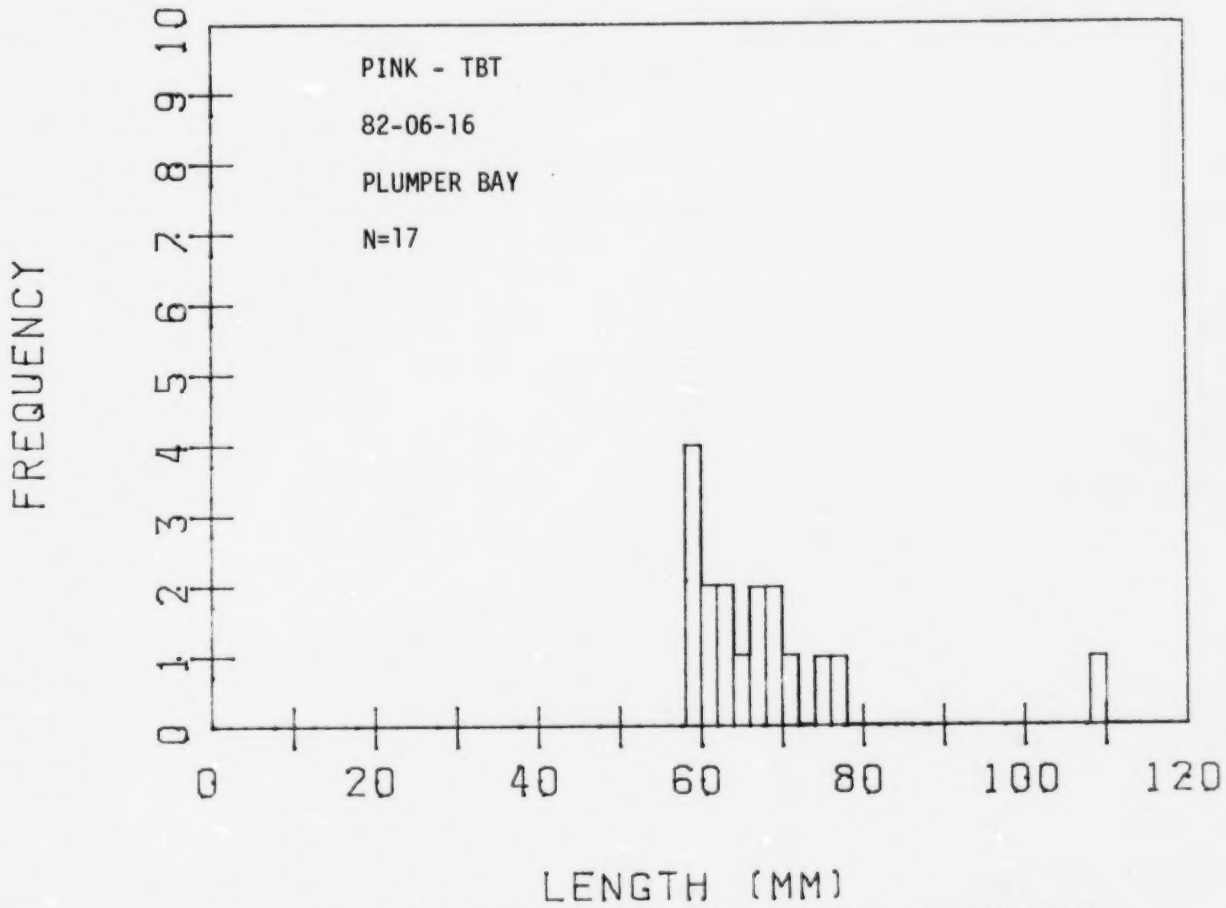

Fig. 4. Length frequency plot for pink taken at Plumper Bay on June 16, 1982.

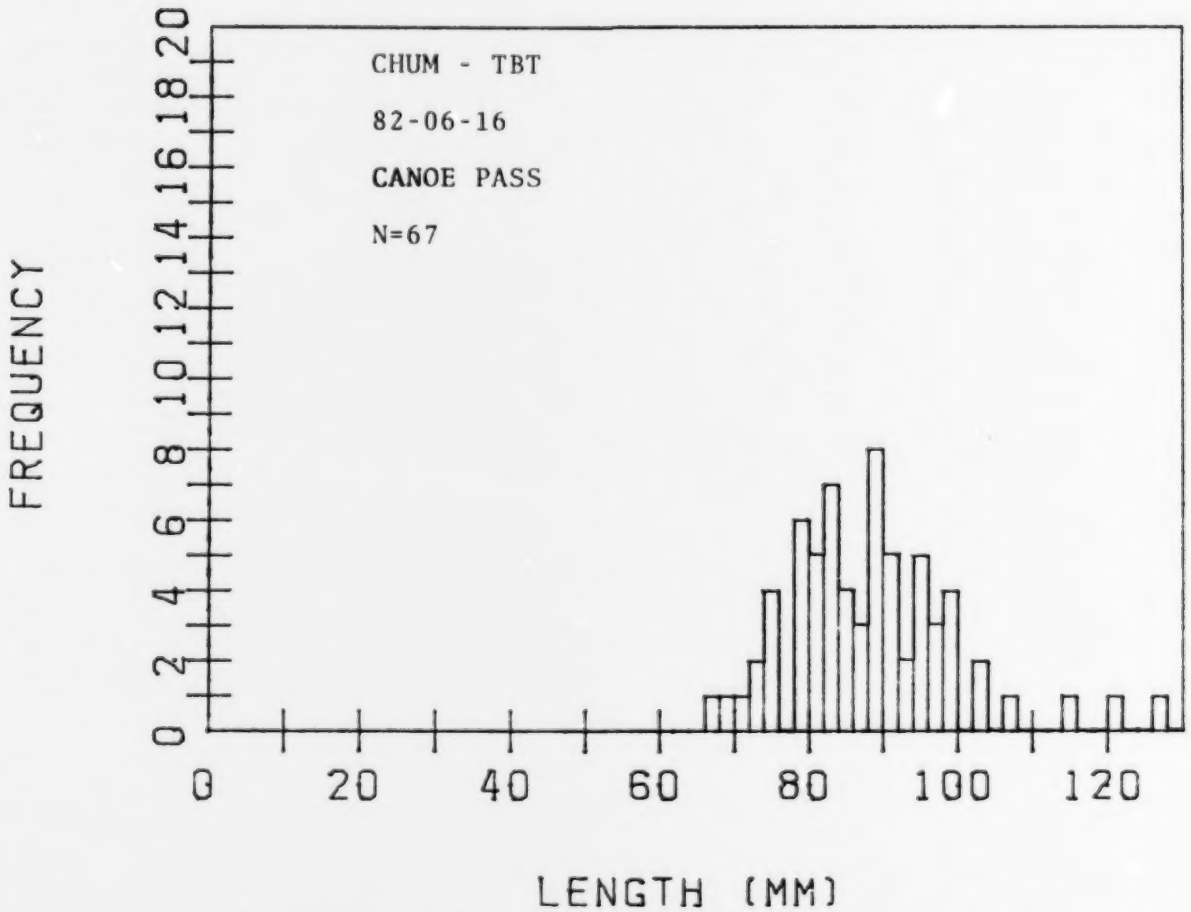

Fig. 5. Length frequency plot for chum taken at Canoe Pass on June 16, 1982.

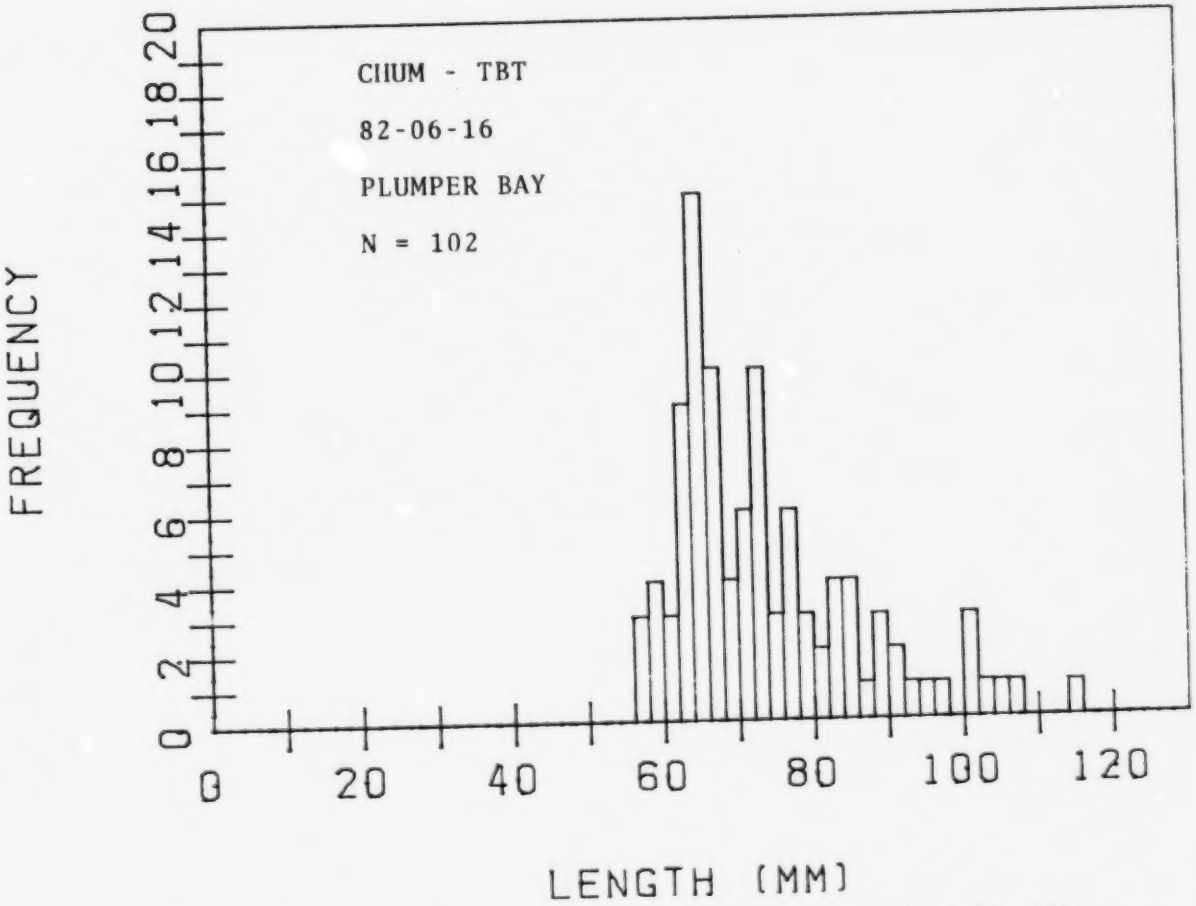

Fig. 6. Length frequency plot for chum taken at Plumper Bay on June 16, 1982.

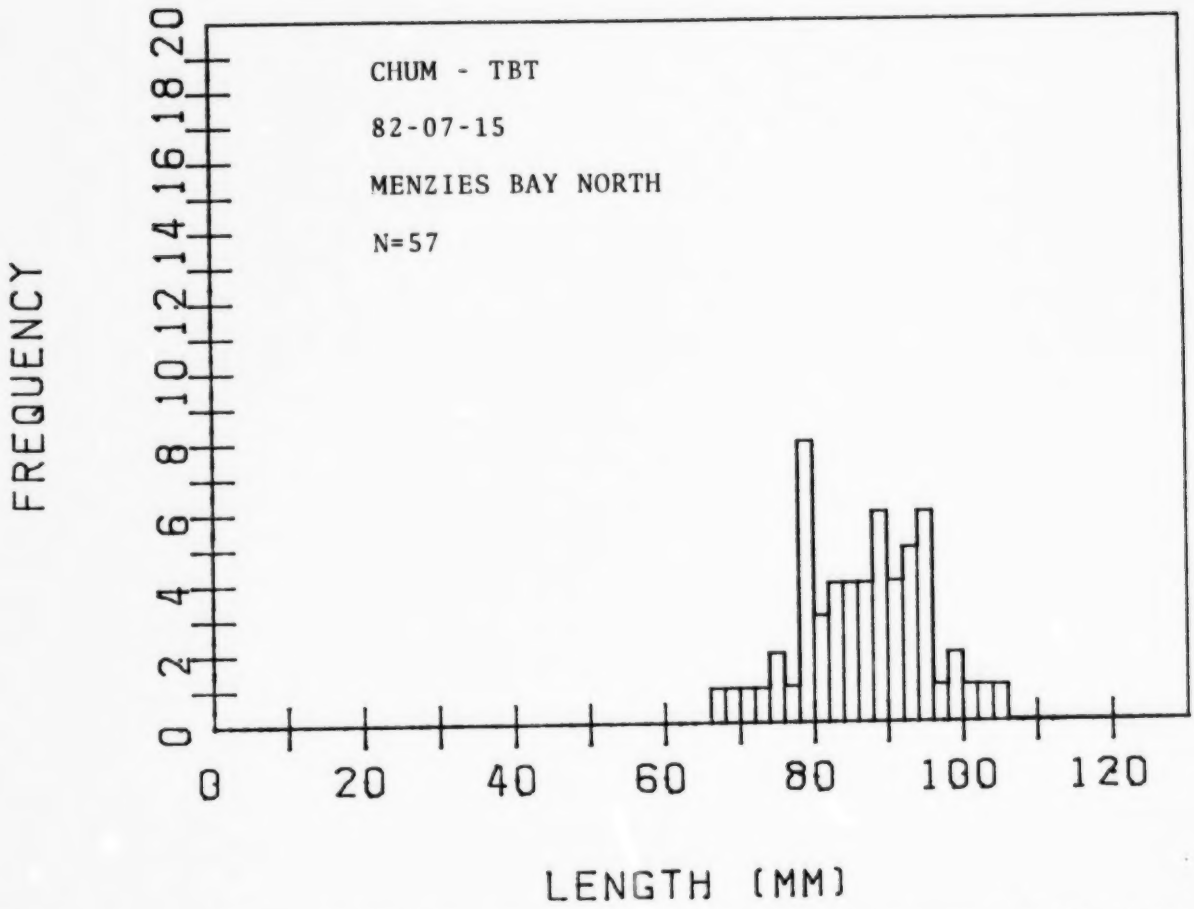

Fig. 7. Length frequency plot for chum taken at Menzies Bay North on July 15, 1982.

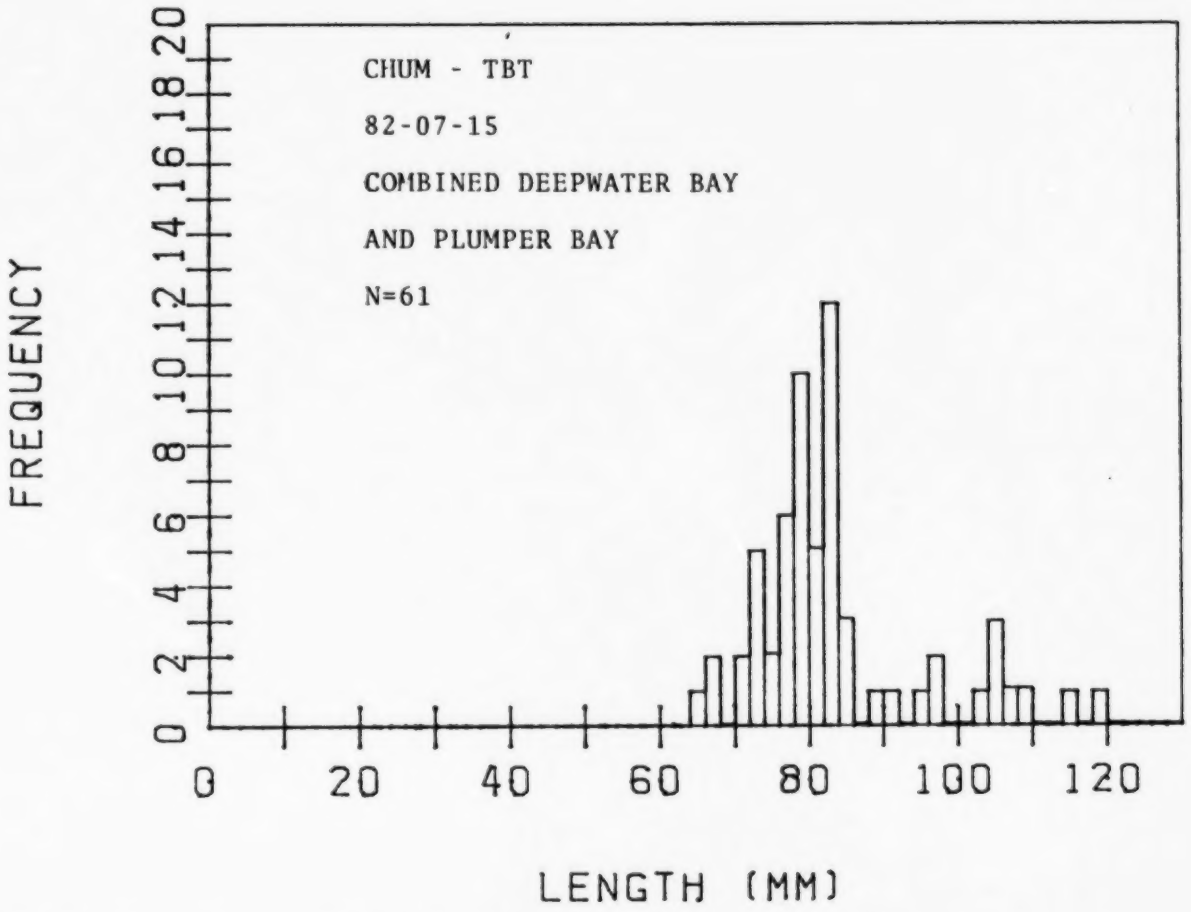

Fig. 8. Length frequency plot for chum taken at Deepwater and Plumper Bay on July 15, 1982.

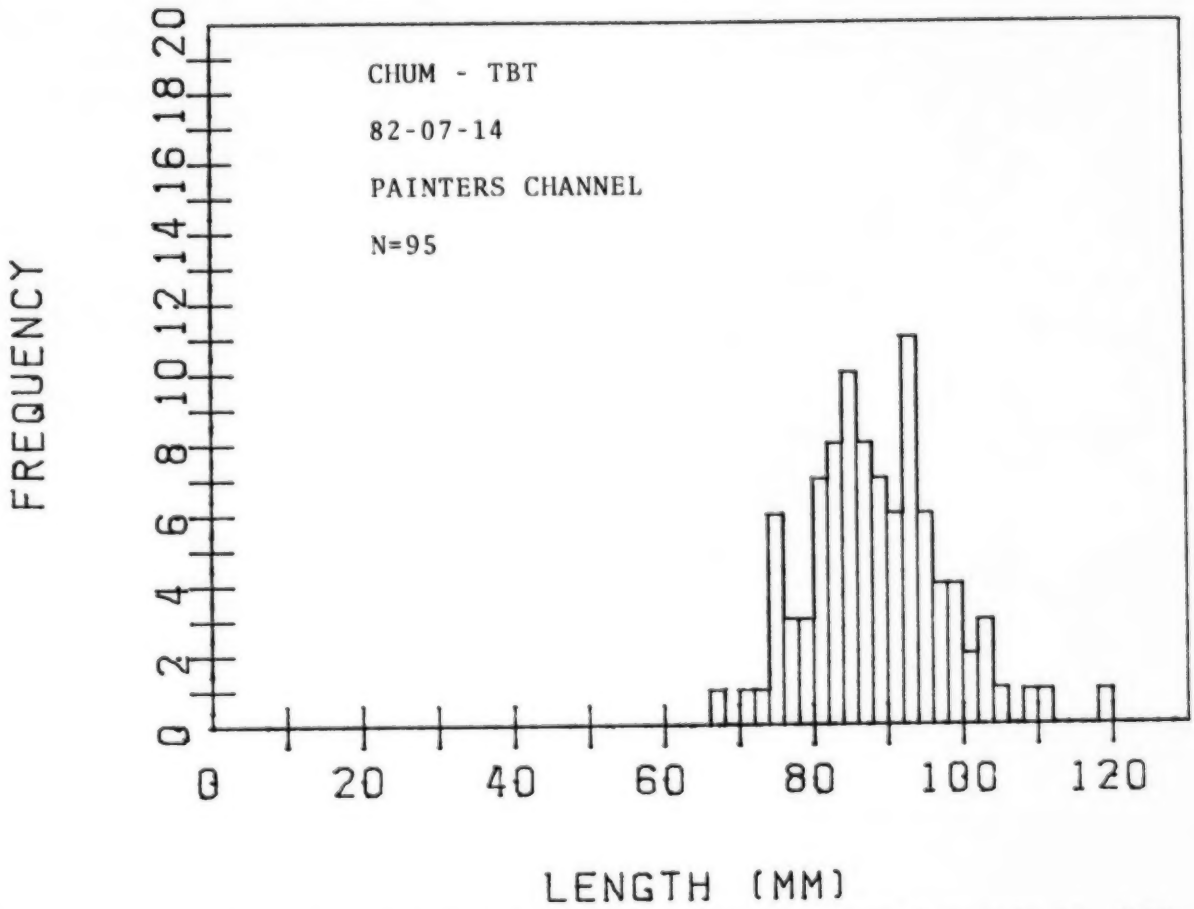

Fig. 9. Length frequency plot for chum taken at Painters Channel on July 14, 1982

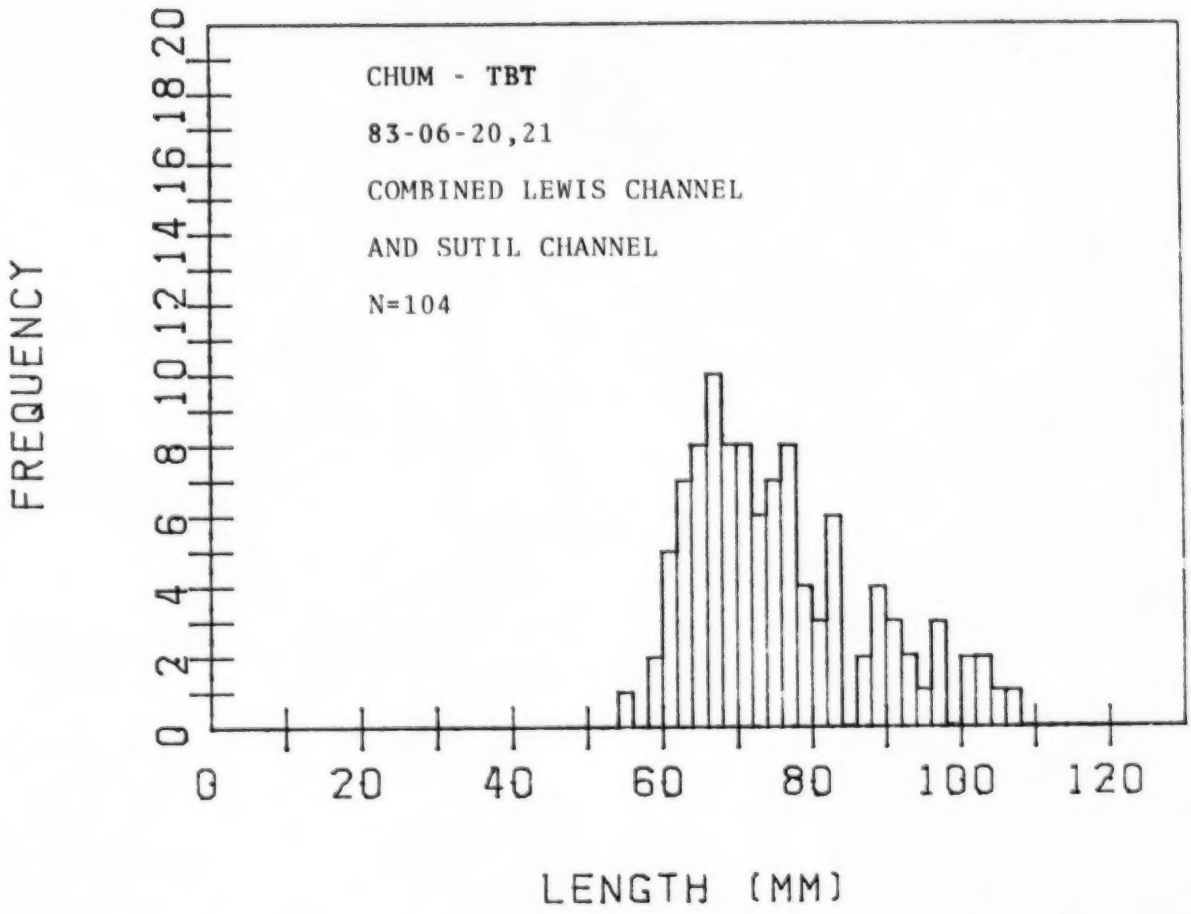

Fig. 10. Length frequency plot for chum taken at Lewis and Sutil Channels on June 20 and 21, 1983.

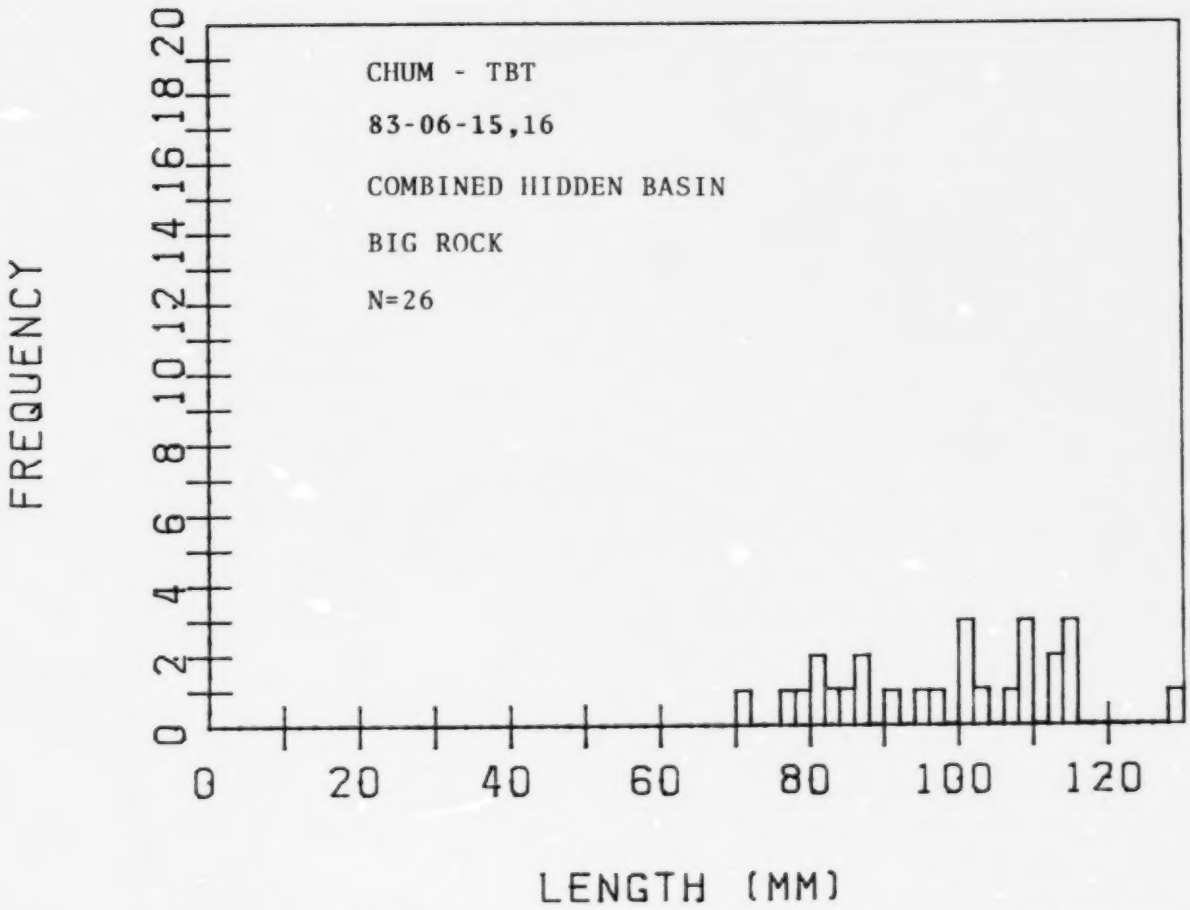

Fig. 11. Length frequency plot for chum taken off Hidden Basin and at the Big Rock station, June 15 and 16, 1983.

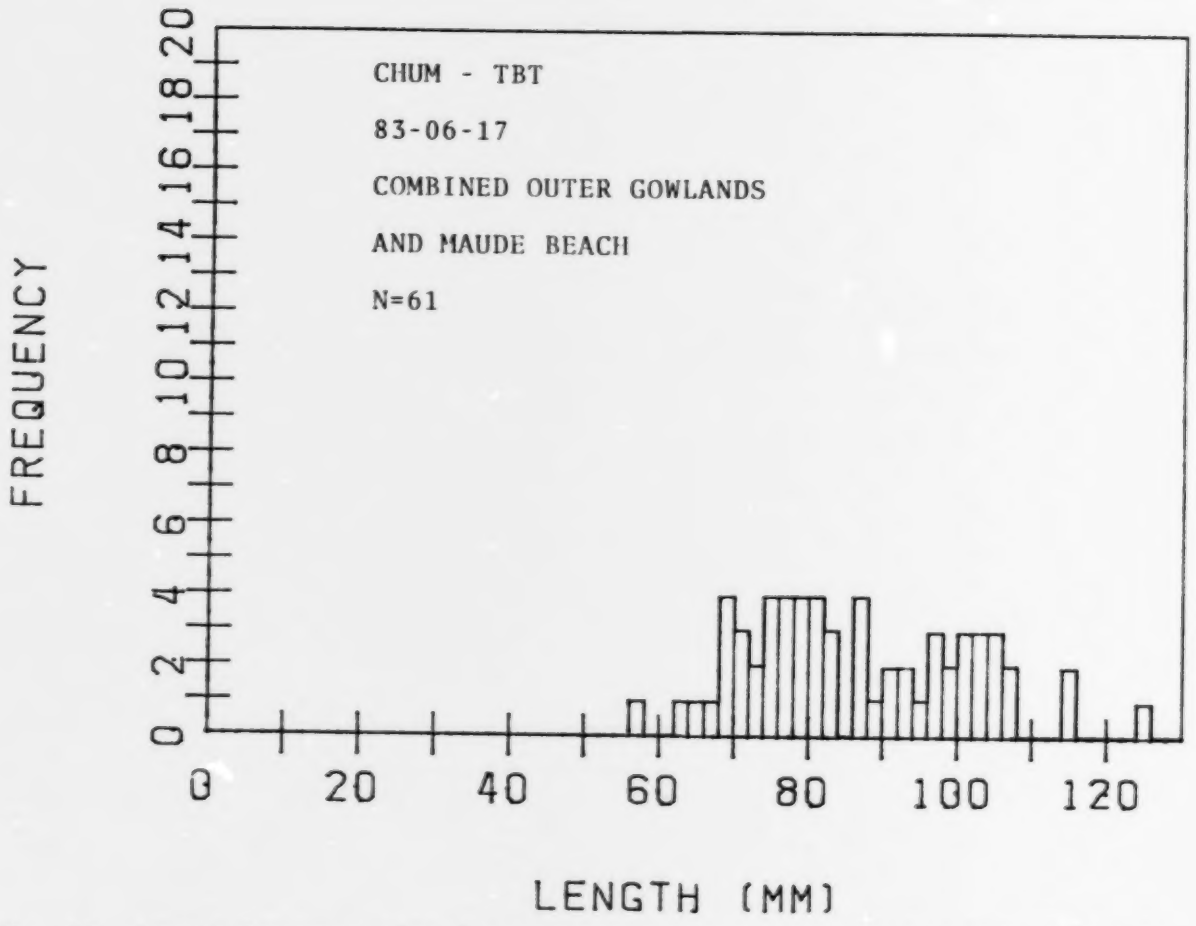

Fig. 12. Length frequency plot for chum taken at outer Gowllands and Maude Beach, June 17, 1983.

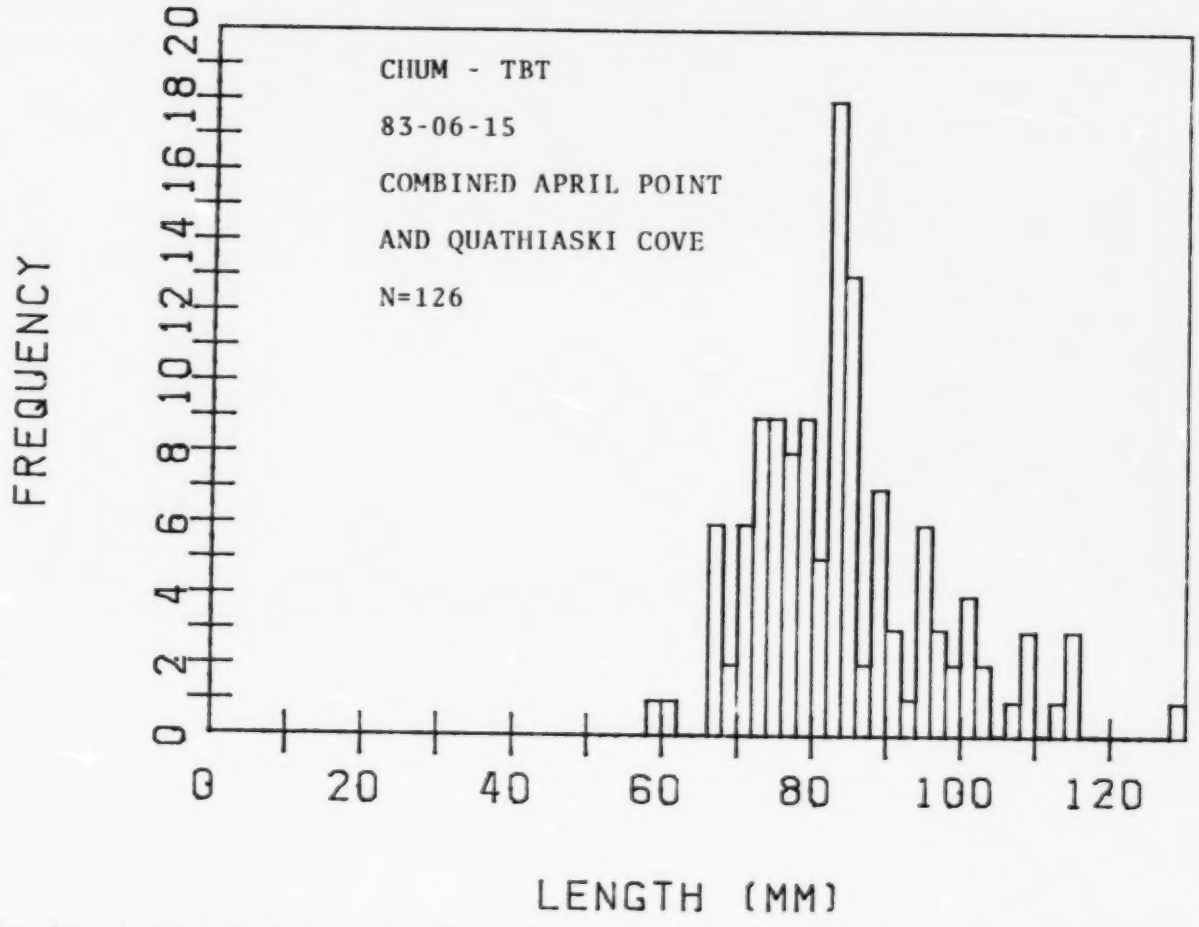

Fig. 13. Length frequency plot for chum taken at April Point and Quathiaski Cover, June 15, 1983.

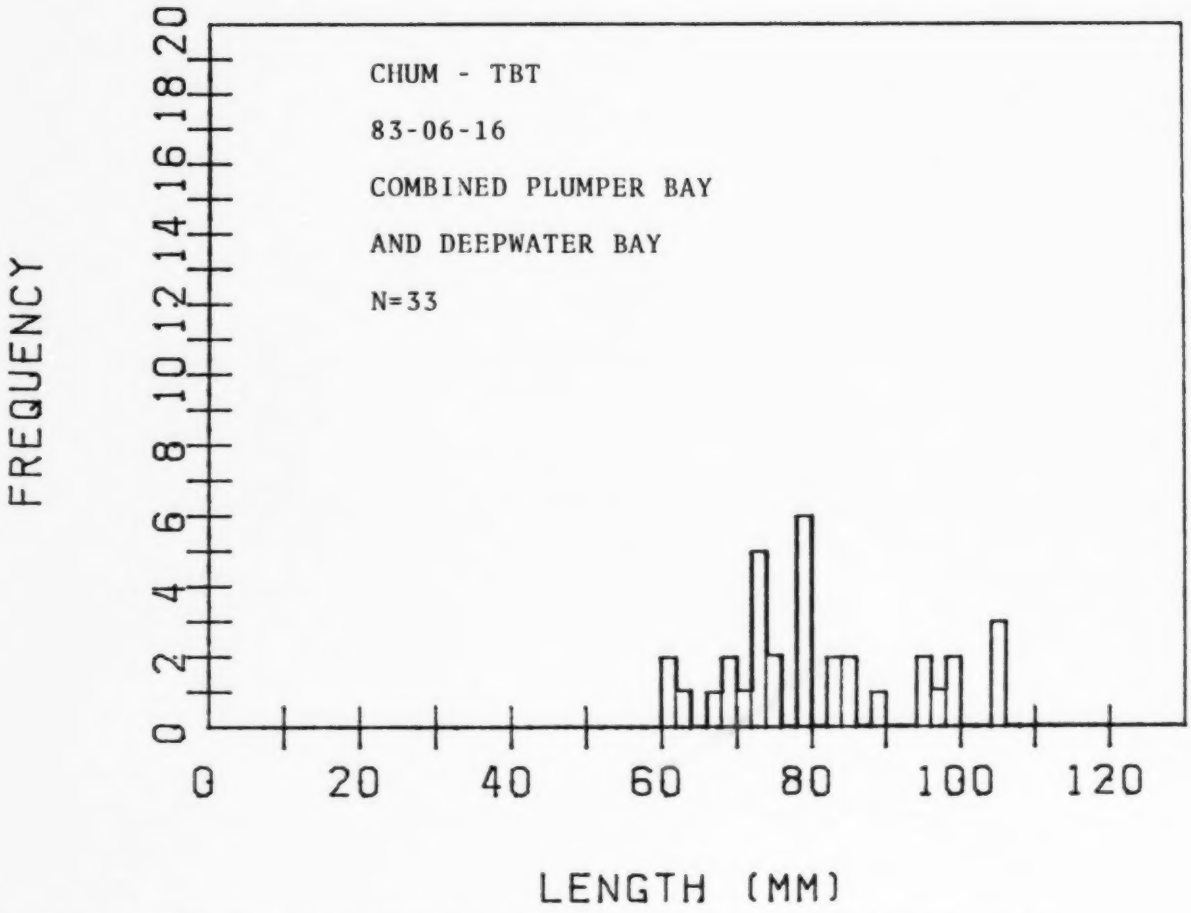

Fig. 14. Length frequency plot for chum taken at Plumper and Deepwater Bay, June 16, 1983

POOR

QUALITY

ORIGINAL